

STANDARD OPERATING PROCEDURE
SURFACE and SHALLOW SUBSURFACE SOIL SAMPLING
SOP NUMBER: ENV 3.13

REVISION DATE: 5/25/2012

SCHEDULED REVIEW DATE: 5/26/2017

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1 Scope and Application

This Standard Operating Procedure (SOP) describes the procedures utilized by E & E for collecting surface and shallow subsurface environmental soil samples. The purpose of soil sampling may range from simple reconnaissance to complex sampling programs. This SOP can be followed for all routine sample collection activities which may include: visual or other observations, in situ or ex situ field measurements (monitoring), or sample collection for biological, chemical, geological, radiological or physical analysis. Site-specific sampling procedures vary depending on the data quality objectives (DQOs) identified in program/project planning documents.

E & E routinely utilizes three types of surface and shallow subsurface environmental soil collection procedures, hand scoop, hand coring, and hand auger. Powered hand augers are sometimes used and the procedure is addressed in this SOP. The definition of the depth of a “surface” soil sample is dependent on the program/project specific DQOs; and may be driven by regulatory, risk-based or other considerations. Hand sampling is generally limited to no more than three feet (one meter) below ground surface. The site-specific depth interval of soil collection is identified in the project planning documents.

Procedures for collecting soil samples for volatile organic compound (VOC) analyses are presented in the E & E VOC Soil and Sediment Sampling SOP ENV 25.

Procedures for collecting “deeper” subsurface soil samples (using back hoes, drill rigs and direct push equipment) are presented in the E & E Borehole Installation Methods SOP GEO 4.7.

Procedures for sample handling are defined in E & E Environmental Sample Handling, Packaging and Shipping SOP ENV 3.16. Site-specific sample handling procedures are dependent on the project DQOs.

Procedures for equipment decontamination are defined in E & E Sampling Equipment Decontamination SOP ENV 3.15. Site-specific equipment decontamination procedures are dependent on the project DQOs.

This surface and shallow subsurface soil sampling SOP is intended for use by personnel who have knowledge, training and experience in the field soil sampling activities being conducted.

2 Definitions and Acronyms

cm	centimeter
DQO	Data Quality Objective
E & E	Ecology and Environment, Inc.
SHASP	Site Specific Health and Safety Plan
SOP	Standard Operating Procedure
VOC	Volatile Organic Compound

3 Procedure Summary

Pre-cleaned spoons, trowels, or other types of scoops are used to collect shallow (usually less than 6 inches [15 cm] deep) soil samples using a hand scoop procedure. Shallow subsurface

soil is collected manually using scoops from the sides of hand dug excavations. Pre-cleaned hand soil core samplers and/or bucket augers are used for collecting relatively undisturbed shallow (usually no deeper than 3 feet [1 meter]) subsurface soil samples. The corer barrel/bucket auger is advanced into the soil to the pre-determined depth identified in the project planning documents. In some cases, corers may include a liner on the interior of the core barrel. Soil cores may be sectioned to provide vertical profiles of soil characteristics.

Disturbed soil samples are collected directly from the auger when continuous flight (screw) augers are used

Unless otherwise specified, surface soil scoop aliquots are combined, homogenized and then placed in appropriate sample containers. Volatile organic and sulfide samples are collected immediately after sample retrieval, regardless of the sampling procedure used. VOC samples are not homogenized (see E & E VOC Soil and Sediment Sampling SOP ENV 25) If multiple samples are required to provide the sample volume identified in the project planning documents, then samples are thoroughly homogenized prior to collection of aliquots for testing.

4 Cautions

This SOP is applicable to routine E & E surface and shallow subsurface soil sampling and is limited to relatively shallow soil sampling depths. Hand augers and corers used in this SOP are generally effective only to a maximum depth of 3 feet (1 meter) below the soil surface. The depth of sample collection will be limited if soil is sandy, clayey or rocky. Grass, roots, or other natural or anthropogenic materials may not be considered part to the soil sample.

Because the sampling devices specified within this SOP provide limited sample volumes, multiple samples may be required to collect sufficient volume for sample analysis. Samples from multiple locations also may be collected and composited to provide a sample representative of a larger area. Sample compositing and homogenization should be addressed in the project planning documents. If a compositing scheme is employed and an area(s) is not visually consistent with other areas, then observations should be noted in the field log and a course of action determined based on the program/project DQOs. Samples for volatile organics, sulfide, or similar analyses are normally collected as discrete aliquots and should be containerized as soon as possible after collection and prior to compositing and homogenization. Field personnel must maintain an awareness of the soil sample volume collected versus the volume required to meet program/project DQOs.

Maintaining sample integrity requires selecting a soil sampling device and procedure that meets project DQOs. Carefully following procedures minimizes the disruption of the soil structure and subsequent changes in physiochemical and biological characteristics.

Continuous flight augers are satisfactory for use when a composite of the soil column is desired.

If a powered auger is used, if possible, position the power unit downwind of the sample location to avoid fumes from fuel used to power the unit.

At sites with known or suspected contamination, based on the data available, samples are collected moving from least to most contaminated soil.

Re-use of equipment may be unavoidable given size and cost. Decontamination matched to DQOs is specified in the project planning documents.

Experience has shown that real-world conditions (e.g., variable soil conditions such as the presence of rocks or trash) may lead to unacceptable soil sample recoveries and multiple attempts to collect soil samples will be required at some locations.

Abandon auger and/or core holes according to applicable regulations. Generally, shallow holes can simply be backfilled with the removed soil material.

Standard measures, such as the use of disposable gloves, that meet project DQOs, are used to avoid cross contamination of samples.

As with all intrusive sampling work, project planning should address the potential for encountering subsurface “utilities” and the measures to be taken to avoid problems in the field.

5 Equipment and Supplies

The equipment and supplies required for field work depend on the program/project DQOs. The following is a general list of equipment and supplies. A detailed list of equipment and supplies should be prepared based on the project planning documents. In general, the use of dedicated or disposal equipment is preferred but equipment may be re-used after thorough decontamination between sample locations (refer to E & E Sampling Equipment Decontamination SOP ENV 3.15).

- Stainless-steel or Teflon™ spoons, trowels, or scoops. Other construction material may be acceptable depending upon the program/project planning documents and DQOs
- Stainless-steel mixing bowls. Other bowl construction material may be acceptable depending upon the program/project planning documents and DQOs
- Hand-driven bucket/continuous flight auger(s), split core sampler(s), and single or multistage core sampler(s)
- Rubber mallet or T-bar to help drive hand augers
- Powered auger(s)
- Spade(s) and/or shovel(s)
- Liners and/or catchers for augers or core samplers as specified in the project planning documents
- Pipe cutter(s), stainless steel knives(s), or power saw to cut liners
- Survey stakes or flags to mark locations
- Ancillary equipment and supplies, e.g., meter stick or tape measure, aluminum foil, plastic sheeting, disposable gloves

Supporting equipment and supplies also may be required to address the following:

- Field logbooks and supplies (Refer to project planning documents and the E & E Field Activity Logbooks SOP DOC 2.1 for details)
- Decontamination equipment and supplies (Refer to project planning documents and E & E Sampling Equipment Decontamination SOP ENV 3.15 for details)
- Sample containers, preservatives, and shipping equipment and supplies (Refer to project planning documents and the E & E Environmental Sample Handling, Packaging and Shipping SOP ENV 3.16 for details)
- Waste handling supplies (Refer to project planning documents and E & E Handling Investigation-Derived Wastes SOP ENV 3.26 for details)

6 Procedures

E & E staff will use the following procedures for completing soil sampling:

- Review relevant project planning documents, e.g., work plan, sampling and analysis plan, quality assurance project plan, health and safety plan, etc.
- Select the sampling procedure(s) that meet project DQOs.
- Refer to the E & E Field Activity Logbooks SOP DOC 2.1 for guidance on the types of information that should be recorded for each sample.
- Refer to the E & E Environmental Sample Handling, Packaging and Shipping SOP ENV 3.16 for guidance on how samples should be labeled, packaged, and shipped.

6.1 Hand Scoop Surface and Subsurface Soil Sampling

- Surface and shallow subsurface soil samples may be collected by hand using scoops.
- Pre-cleaned spoons, trowels, or scoops are used to excavate shallow soil.
- Sample collection intervals are identified in the project planning documents.
- Clear the area to be sampled of surface debris (e.g., twigs, rocks, and litter).
- Carefully remove the top layer of soil to the desired sample depth with a pre-cleaned tool.
- When sampling from the sides or bottom of an excavation, use a pre-cleaned, scoop, spoon, or trowel to remove and discard the thin layer of soil from the area that came into contact with the shovel or spade.
- Collect sufficient sample volume to meet the DQOs identified in the project planning documents
- Place aliquots to be analyzed for volatile organic analytes and/or sulfides directly into sample containers (i.e., prior to homogenization). Procedures for collecting soil samples for VOC analyses are presented in the (see E & E VOC Soil and Sediment Sampling SOP ENV 25).
- Empty hand-collected samples into a pre-cleaned stainless steel bowl (or other type as specified in the project planning documents).
- If multiple hand collected samples are necessary to collect adequate sample volume, they should all be combined in the bowl prior to homogenization.
- Homogenize the sample(s) as thoroughly as possible.
- Transfer sample aliquots to appropriate sample containers and preserve as required in the project planning documents.
- Return unused soil to the excavation, level the area, replace grass turf as necessary.

6.2 Subsurface Soil Sampling with a Soil Core Samplers

This system consists of pre-cleaned corer barrels (with liners and liner caps, as appropriate), caps, core tips, and slide hammer. The dimensions of the core barrel define the volume and depth interval of possible sample collection. Core sampling is recommended if accurate resolution of sample depths is a DQO. Hand coring will generally be limited to 2-inch diameter – 3 foot (1 meter) long samples.

There are a variety of manual soil core sampling devices available for collecting undisturbed soil core samples. Split core, single core, and multistage core samplers may be used with or without liners that are used to avoid contact between the soil and the corer.

The following procedures are used for collecting soil samples with the soil core sampler:

- Assemble the soil core sampler based on manufacturer instructions and project DQOs (e.g., using a liner and/or catcher).
- Clear the area to be sampled of surface debris (e.g., twigs, rocks, and litter).
- Using the slide hammer or sledge hammer or pounding sleeve, begin driving the pre-cleaned corer into the soil until the desired upper sampling depth is reached.
- Carefully retrieve the corer from the boring.
- Decontamination or replace the core barrel with a pre-cleaned core barrel and resume coring. See E & E Sampling Equipment Decontamination SOP ENV 3.15 for decontamination procedures.
- Soil cores should be extruded or split as soon as possible following collection.
 - Place core barrel or liner on clean surface
 - Carefully remove end caps and/or catchers
 - Evaluate compaction (core length versus depth of penetration)
 - For transverse sectioning, beginning at the soil surface, measure and mark the sample sections on the outside of the liner
 - Cut the liner with a manual pipe cutter or core liner and core with a decontaminated saw blade into marked sections.
 - Extrude the soil from the cut segments of the liner. If necessary use a plunger cover with aluminum foil to aid in extruding the core.
 - Empty the core segment into a stainless steel bowl (or other type as specified in the project planning documents).
 - Record observations of the soil types.
 - Immediately collect volatile organic analyte and sulfide samples.
 - For longitudinal sectioning, open the split tube or use a knife to cut the liner and expose the upper half of the soil cylinder.
 - Beginning at the soil surface, measure and mark the sample sections using a tape measure set aside the core.
 - Record observations of the soil types.
 - Immediately collect volatile organic analyte and sulfide samples.
 - Scope the core segment into a stainless steel bowl (or other type as specified in the project planning documents).
- If multiple core segments are necessary to collect adequate sample volume, they should all be combined in the bowl prior to homogenization
- Homogenize the sample as thoroughly as possible

- Transfer sample aliquots to appropriate sample containers and preserve as required in the project planning documents.
- Return unused soil to the boring, level the area, replace grass turf as necessary.

6.3 Subsurface Soil Sampling with Bucket Augers

This system consists of pre-cleaned bucket augers, a series of extensions, and a T-handle. The dimensions of the bucket define the volume and depth interval of possible sample collection. The following procedures are used for collecting soil samples with the bucket auger:

- Attach the bucket auger bit to a drill rod extension, and attach T-handle to the drill rod.
- Clear the area to be sampled of surface debris (e.g., twigs, rocks, and litter).
- Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole until the desired upper sampling depth is reached.
- Decontaminate the bucket auger or replace the bucket auger with a pre-cleaned auger bucket and resume augering. After reaching the desired depth (no more than the maximum length of the auger bucket), carefully remove the auger from the boring.
- Empty bucket auger-collected samples into a pre-cleaned stainless steel bowl (or other type as specified in the project planning documents) OR use pre-cleaned scoops and carefully subsample soil from within the bucket that has not come in contact with the auger.
- Immediately collect volatile organic analyte and sulfide samples.
- If multiple bucket auger collected samples are necessary to collect adequate sample volume, they should all be combined in the bowl prior to homogenization.
- Homogenize the sample(s) as thoroughly as possible.
- Transfer sample aliquots to appropriate sample containers and preserve as required in the project planning documents.
- If another sample is to be collected in the sample hole, but at a greater depth, decontaminate or re-attach a pre-cleaned auger bucket, and follow steps above.
- Return unused soil to the excavation, level the area, replace grass turf as necessary

6.4 Subsurface Soil Sampling with Continuous Flight Augers

This system consists of pre-cleaned continuous flight augers, a series of extensions, and a T-handle. The dimensions of the flight define the volume and depth interval of possible sample collection.

When continuous flight augers are used, the sample can be collected directly off the flights. Continuous flight augers are satisfactory for use when a composite of the soil column is desired.

A powered auger may be used at this time. The following procedures are used for collecting soil samples with an auger:

- Attach the continuous flight auger to a drill rod extension, and attach T-handle to the drill rod.
- Clear the area to be sampled of surface debris (e.g., twigs, rocks, and litter).

- Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole until the desired upper sampling depth is reached.
- Decontaminate or replace the auger flight with a pre-cleaned auger flight and resume augering. After reaching the desired depth (no more than the maximum length of the auger flight), carefully remove the auger from the boring.
- Place auger-collected samples into a pre-cleaned stainless steel bowl (or other type as specified in the project planning documents) OR use pre-cleaned scoops and carefully subsample soil from within the auger flights as it comes to the surface.
- Immediately collect volatile organic analyte and sulfide samples.
- If multiple auger flight-collected samples are necessary to collect adequate sample volume, they should all be combined in the bowl prior to homogenization
- Homogenize the sample(s) as thoroughly as possible.
- Transfer sample aliquots to appropriate sample containers and preserve as required in the project planning documents.
- If another sample is to be collected in the sample hole, but at a greater depth, decontaminate or re-attach a pre-cleaned auger flight, and follow steps above.
- Return unused soil to the excavation, level the area, replace grass turf as necessary.

7 Quality Assurance/Quality Control

Prior to initiating field work, the project planning documents (e.g., work plan, sampling and analysis plan, quality assurance project plan, SHASP, *et al*) should be reviewed by field personnel to identify sampling procedure(s) that will most likely provide surface and shallow subsurface soil samples that meet project DQOs.

The program/project manager should identify personnel for the field team who have knowledge, training and experience in the field soil sampling activities being conducted. One member of the field team should be designated as the lead for soil sampling and will be responsible, with support from other field personnel, for implementing the procedures in this SOP. The program/project manager should also identify additional personnel, if necessary, to complete ancillary procedures, e.g., field logbook documentation, equipment decontamination, sample shipment, and waste disposal.

The soil sampling lead should prepare a detailed equipment checklist before entering the field and verify that sufficient and appropriate equipment and supplies are taken into the field.

Quality assurance/quality control samples (e.g., co-located samples) are collected according to the site quality assurance project plan. Field duplicates are collected from one location and treated as separate samples. Field duplicates are typically collected after the samples have been homogenized. Collocated samples are generally collected from nearby locations and are collected as completely separate samples.

In cases where multiple hand-collected scoop, auger or core samples are required to generate an adequate sample volume, homogenization is important. Field personnel should collect sample aliquots only after mixing has produced soil with textural and color homogeneity.

At sites with known or suspected contamination, samples should be collected moving from least to most contaminated areas.

8 Health and Safety

Prior to entering the field, all field personnel formally acknowledge that they have read and understand the project specific health and safety plan.

Augers and soil core sampling apparatus are inherently dangerous pieces of heavy equipment which a high “pinch” potential. Care should be taken at all times when handling such equipment, not just during sample collection.

Prior to any subsurface work, verify that underground utilities have been located and marked.

9 Special Project Requirements

Project or program-specific requirements that modify this procedure should be entered in this section and included with the project planning documents.

10 References

The following list sources of technical information on soil sampling.

Barth, D. S. and B. J. Mason, 1984, *Soil Sampling Quality Assurance User's Guide*, EPA-600/4-84-043.

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